

## CLAIMS

### WHAT IS CLAIMED IS:

1. An integrated circuit package comprising:
- an integrated circuit die having an active surface; and
  - a cooling fluid in contact with the active surface.
2. The integrated circuit package of claim 1 further comprising:
- an interposer coupled to the integrated circuit die.
3. The integrated circuit package of claim 2, wherein the interposer has a microchannel surface that allows the cooling fluid to flow between the interposer and the active surface of the integrated circuit die.
4. The integrated circuit package of claim 2 further comprising:
- a package substrate, wherein a first side of the interposer is coupled to the package substrate via solder bumps, and a second side of the interposer is coupled to the integrated circuit die via solder bumps.
5. The integrated circuit package of claim 4 further comprising:
- an underfill material disposed substantially between the interposer and the package substrate.

Sub A<sup>1</sup>

2 6. The integrated circuit package of claim 1, wherein the integrated circuit die has a microchannel surface.

1 7. The integrated circuit package of claim 1 further comprising:  
2 a pump to circulate the cooling fluid.

Sub A<sup>1</sup>

2 8. A method of forming an integrated circuit package comprising:  
3 attaching an interposer to a package substrate;  
4 attaching an integrated circuit die to the interposer;  
5 covering the package substrate, the integrated circuit die, and the interposer  
6 with a heat spreader to form an internal chamber;  
filling the internal chamber with a cooling fluid.

Sub A<sup>1</sup>

1 9. The method of claim 8, wherein the filling of the internal chamber is done by  
2 pumping cooling fluid through a via in the package substrate.

Sub A<sup>1,2</sup>

2 10. The method of claim 9 further comprising:  
sealing the via after the internal chamber is filled.

1 11. The method of claim 8, wherein the filling of the internal chamber is done by  
2 pumping cooling fluid through an inlet, and sealing closed the inlet when the filling is  
3 complete.

Sub C 7

FOOTNOTES

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12. A method of cooling an integrated circuit die within an integrated circuit package comprising:

providing power to the integrated circuit die; and

moving a cooling fluid across an active surface of the integrated circuit die.

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13. The method of claim 12, wherein the moving of the cooling fluid is performed by thermal convection.

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14. The method of claim 12, wherein the moving of the cooling fluid is performed by a pump located inside of the integrated circuit package.

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15. The method of claim 12, wherein the moving of the cooling fluid is performed by a pump located outside of the integrated circuit package.

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16. The method of claim 12, wherein the cooling fluid changes phase by evaporating at a first location of the integrated circuit package and condensing at a second location of the integrated circuit package.

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Sub D 10

17. An integrated circuit package comprising:

a package substrate;

a first integrated circuit die having an active surface;

4 an interposer disposed between the package substrate and the first integrated  
5 circuit die, the interposer establishing electrical connectivity between  
6 the first integrated circuit die and the package substrate; and  
7 a cooling fluid disposed between the first integrated circuit die and the  
8 interposer.

1 18. The integrated circuit package of claim 17 further comprising:  
2 a heat spreader covering the package substrate, the first integrated circuit  
3 die, the cooling fluid, and the interposer.

1 19. The integrated circuit package of claim 18 further comprising:  
2 a heat sink coupled to the heat spreader.

1 20. The integrated circuit package of claim 18, wherein the first integrated circuit  
2 die has a microchannel surface in contact with the heat spreader, the microchannel  
3 surface allowing cooling fluid to flow across the microchannel surface.

1 21. The integrated circuit package of claim 17, wherein the cooling fluid is in  
2 contact with the active surface of the first integrated circuit die.

1 22. The integrated circuit package of claim 17, wherein the interposer provides  
2 electrical functionality in addition to electrical connectivity.

Sub C<sup>2</sup>

1 23. The integrated circuit package of claim 22, wherein the interposer provides  
2 capacitance.

1 24. The integrated circuit package of claim 22, wherein the interposer comprises a  
2 second integrated circuit die.

1 25. The integrated circuit package of claim 24, wherein the second integrated  
2 circuit provides an optical to electrical interface for the first integrated circuit die.

1 26. The integrated circuit package of claim 17, wherein the interposer has a  
2 microchannel surface in contact with the active surface of the first integrated circuit die.

FOOTNOTES

Sub A<sup>3</sup>  
2 27. An integrated circuit package comprising:  
3 a integrated circuit die housed within a chamber;  
4 a cooling fluid filling the chamber and in contact with the integrated circuit  
die.

Sub C<sup>1</sup>

1 28. The integrated circuit package of claim 27 further comprising:  
2 a plurality of microchannels in a surface of the integrated circuit die.

1 29. The integrated circuit package of claim 28 further comprising:  
2 a pump located within the integrated circuit package to pump the cooling  
3 fluid through at least a portion of the plurality of microchannels.